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VACCINATION; ^{Sp 13/2}

BY

PROF. C. A. LINDSLEY, M.D.,

MEDICAL DEPARTMENT, YALE COLLEGE, DECEMBER, 1881.

*"Nothing however beneficent can escape the criticism of the times in which we live. The criticism of vaccination, often passionate and violent, relates chiefly to points which, however interesting they may be, leave the main question unaffected. We may speculate about the possibility of the potency of vaccine being exhausted in the human family; we may be surprised to find that people with good vaccine scars sometimes have Small-Pox; we may dispute as much as we please about the average period when re-vaccination may be considered a prudent safe-guard; * * * but after all we find that we rest in a security against the horrid pestilence of Small-Pox unknown to former generations."—DR. GEORGE DERBY.*

FROM THE REPORT OF THE SECRETARY OF STATE BOARD OF HEALTH.

HARTFORD, CONN.:

THE CASE, LOCKWOOD & BRAINARD CO., PRINTERS.

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VACCINATION.

BY C. A. LINDSLEY.

It is one of the recognized duties of the State Board of Health to acquire and diffuse among the people such information concerning the care and protection of their health as will be of practical use to them.

The fields of study pertaining to public hygiene are wide and varied, and among them all there are few, if any, at the present time, of greater significance than vaccination. There are few, if any, topics, which deal with human life at all approximating to the importance of this, respecting which there is so much misinformation and unfounded prejudice in the public mind.

It is, therefore, an eminently proper subject, upon which the people should have correct information, that their unjust prejudices may be removed and that they may enjoy the best results of this beneficent boon.

It is the purpose of the present paper to state, in brief and plain language, what vaccination has done for the human race and how it can be employed most safely and effectively.

In 1798, more than eighty years ago, it was announced by the great Jenner that the inoculation of vaccinia, or cow-pox, in the human subject was a full and sure protection from small-pox. Probably no single discovery ever made by man has contributed so much to human longevity. The greatness and value of this specific preventive of small-pox can never be successfully controverted.

The claim of Jenner that vaccination is competent to exterminate small pox and to wipe out from the list of human ills this loathsome contagion is now established by the verdict of science, as based on the experience of millions and millions of facts, noticed by the best medical observers and thinkers in the world.

For the very reason that its protective power is so nearly infallible and its use so nearly universal, the present generation are comparatively exempt from small-pox, and therefore cannot and do not adequately appreciate the magnitude of the blessing which Jenner's discovery has conferred upon mankind. Vaccination owes its whole importance to its relations to small-pox. It confers upon the human system no new advantages, but rather is temporarily itself a source of some discomfort and suffering. Its whole value consists in its power of protecting one from that most fatal of human maladies, the small-pox. Its general observance and practice is in obedience to the law, "Of two evils one should choose the least."

WHAT HAS VACCINATION DONE?

We can best understand the question by inquiring about the prevalence of small-pox in the last and previous centuries as compared with its prevalence now.

In past times, throughout Europe and in other countries small-pox was universally regarded as one of the greatest scourges of mankind. The bills of mortality during the last half of the last century showed that ninety-six one-thousandths, almost one-tenth, of all the deaths in London occurred from this sole cause. In the great cities, on an average of a long series of years, it can be shown that one-third of all the deaths which took place in children less than ten years old arose from small-pox.

"Not a decade passed in which the disease did not decimate the inhabitants in one country or another, or over great tracts of country; so that it came to be more dreaded than the plague."

In Berlin, according to Caspar, from 1783 to 1799 small-pox caused one-twelfth of the total mortality.

In France, 30,000 persons perished annually of this disease. Medical treatment availed but little to stay its ravages. A proverb of the time illustrated how resignedly the people accepted their fate: "From small-pox and love but few remain free."

Among remote communities, where it had not previously prevailed, and where therefore none were exempt from its contagion by previous suffering, its ravages have been fearful to contemplate.

In 1518, it made complete the depopulation of St. Domingo, previously begun by sword, fire, and famine. Mr. Prescott, in his "Conquest of Mexico," describes an epidemic as sweeping over

the land like fire over the prairies, smiting down prince and peasant, and leaving its path strewn with the dead bodies of the natives, who (says another) "perished in heaps like cattle stricken with the murrain." Washington Irving's "Astoria" mentions several epidemics among the American Indians in which "almost entire tribes" were destroyed.

During a single year, about 1560, says De la Condamine, it destroyed, in the province of Quito, upwards of 100,000 Indians. In later days, we have accounts of epidemics raging with no less destructive power over Kamschatka, Greenland, and Iceland.

Its extreme severity in these latter-mentioned instances was due to the infection being suddenly spread among peoples, none of whom were exempt by previous attacks. In civilized countries, where intercommunication was constant and the contagion continually conveyed about by uninterrupted intercourse, the disease perpetually existed in all communities, but finding subjects only among those who had not already had it, and were so exempted. So general and so contagious was the infection that very few passed childhood without the consequences of exposure to it; and hence an adult person not pit-marked in the face was the exception to the general rule.

But the deaths from small-pox fall far short of a full realization of its evils. It was not fatal to all its victims. The survivors of the malady were, in many instances, only spared from death to be lifelong sufferers from various severe physical afflictions, which, if not soon fatal, marred the enjoyment of life and often abbreviated its duration.

The great English historian Macauley eloquently compares the evils of small-pox in England toward the end of the seventeenth century with the ravages of the plague. He gave small-pox the prominent eminence among destructive agencies, calling it, "the most terrible of all the ministers of death." * "The havoc of the plague," he said, "had been far more rapid; but the plague had visited our shores only once or twice within living memory. The small-pox was always present, filling the churchyards with corpses, leaving in those whose lives it spared the hideous traces of its power, turning the babe into a changeling, at which the mother shuddered, and making the eyes and cheeks of the betrothed maiden objects of horror to the lover."

* History of England, vol. IV, p. 530.

Survivors often found that although life was spared the boon was of questionable value, it was so much shorn of what made life enjoyable.

In many, sight or hearing, or both, were impaired or totally lost; and thus maimed, mutilated and disfigured, they dragged on a sickly, miserable existence, to become speedy victims to consumption, scrofula, or some other fatal disorder.

Sir Gilbert Blaine stated that the report of the Hospital for the Indigent Blind showed that two-thirds of its beneficiaries had lost their sight by small-pox.

The people of the present day have no familiarity with the horrors which small-pox may cause when uncontrolled. In our times, the happy immunity which we enjoy, the almost entire exemption of the present generation from the ravages of this dread destroyer of life and happiness, is wholly due to the protective power of vaccination.

So well is this understood, that in all communities where health boards exist, clothed with adequate authority and being intelligently alert, small-pox is never permitted to be propagated beyond the first few cases in which it may occur.

Vaccination is therefore a subject of such considerable import as a measure of public hygiene, that it deeply concerns every community upon which it is practiced not only that it shall be done, but done in the best, safest, and most efficient manner.

There are several questions which present themselves demanding answers, before deciding how vaccination may be most successfully employed in aid of public hygiene.

Shall vaccination be compulsory ?

What virus should be used ?

What are the evidences of a successful vaccination ?

How often should vaccination be repeated ?

Who are proper subjects for primary vaccination ?

Who are proper subjects for re-vaccination ?

COMPULSORY VACCINATION.

The question of *compulsory* vaccination is one of too much magnitude to be fairly discussed in this paper. I will therefore dismiss it with the statement that it is practiced in several countries in Europe, and partially in several States of the Union. Thus Massachusetts and Rhode Island require all attendants upon the public

schools to be vaccinated before they can be admitted. Hartford is the only city in this State, so far as the writer knows, where vaccination is made a condition of admission to the public schools. The same requirement is enforced upon the beneficiaries of other public institutions in many places. And wherever compulsory laws exist and are enforced they supply the most satisfactory and conclusive evidence of the value and power of vaccination in protecting the public health.

THE QUALITY OF VACCINE VIRUS.

There are several varieties of vaccine virus.

1. That obtained directly from a young and healthy heifer which has been inoculated with virus transmitted by the same process of inoculation through previous heifers in succession from a cow having the disease, cow-pox, in the natural way. This kind is called *bovine virus*.

2. Virus obtained from the human subject after successful inoculation with any active vaccine virus. This kind is called *humanized virus*, because it has been transmitted through the human subject.

The humanized and the bovine, as above defined, are the forms almost exclusively employed at the present time. But there have been and are still in occasional use other kinds of bovine virus. Theorists and experimenters have used virus obtained by inoculating kine with the products of human vaccination. This is called *retro-vaccination* and is practiced in the expectation that by passing again into the system of the cow it will recover any virtues it may have lost by frequent transmission through the human system.

More reckless theorists and experimenters have inoculated the cow with the pus of small-pox taken from the human subject. This is called *variolation*.

Still another kind of vaccine virus has been obtained by inoculating kine with the matter from a similar irruptive disease of the horse, the horse-pox. This is called *equination*.

These three forms of bovine virus last mentioned, viz.: retro-vaccination, variolation, and equination, are not frequently resorted to in this country as a source of supply, and as this paper is intended to be practical, the consideration of them may be disposed of very briefly.

Retro-vaccination or the inoculation of kine with vaccine lymph which has been humanized, has not resulted as was expected, in

restoring any lost powers or energizing the active virus of the lymph. Observers very unanimously agree that the lymph so produced is not at all improved in quality by transmission through the cow. On the contrary, it is weaker in infectiveness until it has again become humanized by one or more passages through the human body.

The scientific fact that humanized vaccine is not improved by retro-vaccination, being now satisfactorily determined, and the operation being rarely successful, it is quite probable the practice will fall into disuse.

In this country it has never been much practiced except in an experimental way, but in Naples and other parts of Italy it has been more prevalent.

The attempt to renew the stock of vaccine virus by inoculating cows with the lymph of small-pox from the human subject has been made many times. Variolation is not so often successful as retro-vaccination. Seaton says, "that for one case in which the inoculation succeeds it will fail in at least a dozen." Martin, the best authority on vaccination in this country, says, "that on the fingers of one hand may be counted the experimenters who even claim success." There is, however, satisfactory evidence that it has occasionally proved successful; notably in England, where virus propagated from such original stock has been employed in many thousands of cases with such results as to remove all doubts of its protective power. On the other hand, says Dr. Martin,* "more than once or twice virus resulting from such experiments, issued widely by jubilant *savans*, has been employed, and the result has been a wide diffusion of small-pox." Hence the propriety and safety of variolo-vaccination is very questionable. Virus from this source is not at present used in this country.

Equination or the inoculation of kine with the horse-pox is another mode of developing the disease, but as it is chiefly interesting in its scientific aspects, is difficult to accomplish and not demanded by any need for vaccine supply, it is a matter of little practical concern.

Excluding, then, retro-vaccination, variolation, and equination as belonging more to the domain of scientific pathology than to the daily duties of the medical practitioner and the interests of his patients, we may confine our attention to the study of the ordinary

*Trans. Amer. Med. Assoc. 1877.

form of bovine virus as derived by inoculation of kine from an original case of cow-pox, and of the humanized virus as obtained by passing the bovine through the human system.

Let me here state that all the bovine virus now used in this country is of the "Beaugency" stock. On the 26th of April, 1866, a case of spontaneous cow-pox in a milch cow was discovered at Beaugency, near Orleans, in France. From this cow another cow was inoculated, and from the second still others, usually heifers, in succession without interruption down to the time of the Franco-Prussian war, when for most evident reasons the succession of the "stock" was lost, in France. But most fortunately for America, and perhaps even for the world, through the philanthropic enterprise and energy of that celebrated vaccinator, Dr. Henry A. Martin of Boston, some of this virus was brought by special messenger to him, in September, 1870. The virus he received was from the 258th, 259th and 260th of the series from the Beaugency cow. Dr. Martin and his son, who some years ago succeeded him in the business, have perpetuated it uninterruptedly to the present time. All the other producers of bovine virus in this country have their stock from Dr. Martin, Senior or Junior. The interesting question respecting bovine and humanized virus as just defined is, Which is the best? The true answer will be based upon the comparative protective power of each, and the effect of each as liable to influence subsequently the health of the party vaccinated.

WHICH IS MOST PROTECTIVE, BOVINE OR HUMANIZED VACCINE VIRUS?

Let us first correct a popular error, which is, that no person can suffer from small-pox twice; that one attack of small-pox is an infallible safeguard against future attacks. Many well-authenticated instances are on record of the same individual suffering twice and even three times with the disease, and in some cases the last attack was not modified by those previously endured. Small-pox, then, does not always prove an infallible protection from small-pox. It is not reasonable to expect that vaccination should be any more protective than the disease itself. So, as small-pox does not infallibly protect its victims from future seizures, neither is vaccination an absolutely infallible protection. There is good reason, however, to believe that vaccination properly performed with genuine active vaccine lymph *is just as protective as an attack of small-pox*. It is not reasonable that it should be any more so.

But small-pox in any form very rarely occurs again in a person who has once had it. It is the marked exception to the rule. But small-pox in a form called varioloid is not now very uncommon in persons who have been vaccinated. In most such cases vaccination has not proved as protective as small-pox would have been. Where shall we find an explanation of this defective protection? Let us cast a glance back at the early history of vaccination and observe its results along from time to time, down the four score years it has been in use.

Jenner made his first vaccinations with the lymph of the original disease, cow-pox, as it occurred naturally in the cow; and his subsequent vaccinations were made with lymph taken from the human subject. Having once inoculated mankind with the disease, the product of that inoculation was used in other human subjects, and thus it has been transmitted by successive vaccinations of persons, through thousands and hundreds of thousands of human beings from the time of Jenner down to the present. Jenner believed that the humanized vaccine lymph lost none of its efficacy by transmission through the human body. That belief is still shared by many physicians at the present time. But from an early period in the practice of vaccination, there have been some to call in question this faith, and to doubt if humanized vaccine does not become gradually enfeebled by so many successive transmissions without, however, altogether losing its preservative property. Now because, until within quite a few years, the use of humanized vaccine has been almost universal; and because the National Vaccine Institution of England has maintained, from the time of Jenner to the present, this mode of propagation without renewing the stock from the original source in the cow, it is possible to compare the results of vaccination in the earlier years with those of the later, in the cases in which virus of shorter and longer humanization has been exclusively employed.

Fortunately the statistical records found in the literature of the subject, from the beginning of the century onward, enable us to arrive at very reliable conclusions about the matter. The limits of this paper forbid a lengthy and exhaustive analysis of the statistics. I can only illustrate the prominent facts which they develop by quoting a few of the most convincing statements. In London, during the decade 1870-9, in every million of inhabitants 4,779 died of small-pox. Of these so large a proportion died in hospitals, where observations were accurately recorded, it was pos-

sible to determine that over 37 per cent. occurred in persons who had been vaccinated.

The returns of the Registrar-General show also that during the same decade over 1,800 deaths from *post-vaccinal* small-pox occurred in London, in every million of vaccinated persons.

It is just as clearly shown by statistics, that only one case in ten of post-vaccinal small-pox was fatal; hence for 1,800 deaths there must have been 18,000 sick of the disease to every million of the vaccinated population. These were the facts in the last decade, 1870-9. Now let us look back, and contrast the facts of a similar period, in the early part of the century. During the first ten years, 1800-9, the medical profession almost universally believed that vaccination, except in the rarest instances, prevented small-pox altogether. It must be remembered, too, that this faith was based on careful observation. Jenner's discovery was not universally and unanimously received, but on the other hand met with violent opposition and the most unreasonable objections were at first urged against it. There were more anti-vaccinators in the first decade of the century than there are now. The advocates of vaccination believed, with Jenner, that the protection which vaccination would afford to be exactly that which an attack of small-pox would confer against a subsequent attack. They believed its protection to be neither more nor less than that. The anti-vaccinators therefore would have hailed with hilarious delight such facts as, that 37 per cent. of the deaths from small-pox were of persons who had been vaccinated; that the post-vaccinal deaths were at the rate of 1,800 in every million of vaccinated persons, and that 18,000 were sick in the same number. It is wholly inconceivable that such facts existed in the first decade of vaccination or any thing approximating to them, and yet failed to be observed by the watchful and zealous antagonists of vaccination. It is not possible that such facts could then have existed and escaped observation. The protective efficacy was then being tested and its results were watched with the most careful scrutiny both by its advocates and its opponents.

Jenner announced his discovery in 1798. A committee of the House of Commons, appointed in 1802, to inquire respecting the merits of his discovery, for determining if he was deserving of a national reward, after hearing all that the enemies of vaccination had to say, could discover only two cases in which small-pox had occurred after vaccination had been properly performed. In 1806 the Medical Council of the Royal Jennerian Institute admitted the

occurrence of post-vaccinal small-pox, but declared it to be "very rare" and "generally so mild as to lose some of its characteristic marks, and even to render its existence doubtful." In 1811 the National Vaccine Establishment carefully investigated and published an account of two cases in their report for the year. They mentioned one of these as the severest that had yet occurred to them, and also reported that it was their belief that, "since the practice had been fully established, *no deaths* from small-pox had in any instance occurred after vaccination." This was in 1811, thirteen years after vaccination was begun; and as yet no fatal case known of post-vaccinal small-pox. Remember, too, that the exposure to its contagion was vastly greater than now, because it was constantly prevalent. After 1810 the practice had become very general in other countries and cities of Europe, and the statistics were carefully recorded. They show a like exemption from the contagion of small-pox after vaccination. In Copenhagen, then a city of over 100,000 inhabitants, where vaccination was universally practiced, not a single death from small-pox was registered during the thirteen years from 1811-1825. In Annsbach, in Bavaria, with a population of 300,000, at that time thoroughly vaccinated, no death occurred from small-pox during the nine years, 1810-18. Between 1804 and 1813, more than two and a half millions of people were vaccinated in France, and only seven individuals of those were known to have taken small-pox.

It was not until vaccination had been practiced fifteen or twenty years that post-vaccinal small-pox became at all common or frequently fatal. Since then, however, the frequency of post-vaccinal small-pox has been steadily and regularly increasing everywhere where the long humanized vaccine virus was employed. Wherever reliable statistics have been recorded, this fact is made evident. In France, from 1819-35, there were recorded 5,467 cases of small-pox after vaccination, of which 51 were fatal. In Switzerland, between 1822-32, 4,211 cases occurred, with 92 deaths. In Copenhagen several epidemics occurred from 1825-35, in which there were 3,093 post-vaccinal cases and 66 deaths. In the London small-pox hospital, between 1826-35, there were 915 such cases, and 54 deaths, as reported by Dr. Gregory. By comparing these fifteen years, 1819-35, with the first decade of the century, a very conspicuous increase of small pox after vaccination is made evident, as well as an increased intensity of the disease, as shown by the more frequent deaths; the mortality being nearly 2 per cent.

as against a small fraction of 1 per cent. in the earlier period. But during the period from 1836-52, as appears by the carefully kept records of Dr. Marson, of the London small-pox hospital, the mortality of post-vaccinal cases has increased to 6.9 per cent. From 1852-67, even under better hygienic conditions, the death rate, still advancing, reached 7.6 per cent. in the same hospital. And in the last decade, 1870-79, there were 15,000 cases, with a death rate of 9.2 per cent.*

Whatever view of the statistics of vaccination, as practiced with long-humanized virus, one may take, the conclusion is irresistible, that the earlier the period in the use of vaccination, the smaller was the death rate, and the later the period the larger it becomes. From a fraction of one per cent. previous to 1820, it has reached nearly 10 per cent. in 1880.

What better demonstration is possible, that vaccination with long-humanized lymph has degenerated, than this showing affords? The most legitimate conclusion from the foregoing history of vaccination is, that long-humanized vaccine lymph gradually deteriorates; that virus obtained directly from the cow or heifer is far more protective than that which has been transmitted by repeated inoculations through successive human systems for eighty years; that the fewer removes it is from the original source the more protective it is.

No one has called in question the efficacy of animal vaccination. There can be no reason to suppose that it is any less protective now than in the time of Jenner, or that humanized virus, which is but few removes from its source in the cow, is any less protective now than the humanized virus of an equal number of removes in Jenner's day. But there are other evidences of difference than the comparison of results as regards protective power. Let one notice the beginning, progress, and termination of two vaccinations, upon two subjects, or upon opposite arms of the same subject; the one with humanized virus of ancient derivation from the cow, and the other with that fresh from the heifer. The most noticeable differences are in the development of the vesicles and the duration of the induced disease, *vaccinia*. In the case of the long-humanized virus, that of the Jennerian "stock" of the "English Vaccine Establishment," the areola commences at the end of the seventh or beginning of the eighth day. The bovine virus is slower by two

* I am largely indebted to Charles Cameron, M.D., M.P., for the above statistics, in the *Fortnightly Review* for May, 1881.

days, the areola beginning not until the latter end of the ninth or early part of the tenth day, and declining at the end of the twelfth and often not until the thirteenth and fourteenth day. In the humanized virus the whole course of the vaccine disease is often finished and the crust separated on the fourteenth day after the insertion of virus. But the crust of the bovine vaccination never loosens before the twenty-first day, and often not until the twenty-fifth, and even sometimes remaining adherent until the thirty-second. Besides these visible differences in the local manifestations of the disease, there are others, such as altered characteristics of the crusts, and resultant cicatrices, all indicating that the impression made upon the system is correspondingly diminished; and they satisfactorily explain why post-vaccinal small-pox is gradually and steadily increasing in frequency and fatality, after vaccination with the long-humanized virus.

Now what evidence exists respecting the protective power of bovine virus? Animal vaccination is the original form in which the dairy-maids and dairy-men of Gloucestershire, England, were protected, and from whose experience the great Jenner evolved the discovery. Is it equally effective now as it was then? is the important question.

Dr. J. L. Meares, health officer of San Francisco, writes in his last annual report as follows: "The bovine virus (Beaugency stock) has been exclusively used by the health department since its introduction here five years ago. The vaccinations since that time reach the large number of over 80,000. This is exclusive of the vaccinations performed by the physicians of the city generally. . . . I have yet to see a case of variola or varioloid after a successful vaccination with bovine virus."

Still stronger evidence on this point is that of E. Warlomont, M.D., Director of the State Vaccinal Institution at Brussels. He says that, "out of more than ten thousand vaccinated at Brussels with animal vaccine, from 1869 to 1870, not one case was to my knowledge noted as having been attacked by the epidemic which terrified the world in 1870 and 1871." In 1878 Dr. Warlomont, at a meeting of the Académie Royale de Médecine of Belgium, made an appeal to his colleagues in the following terms: "I have previously said that no such case has been reported to me. I repeat it, and up to the present time, and not one of the numerous medical men whom I have interrogated on the subject has contradicted me. Has there really not been any? That seems to me impossible.

However it may be, I appeal to hospital physicians and those gentlemen attached to charitable institutions to clear up this fact, which, in consequence of the deduction to be drawn from it, requires to be rigorously verified." In the present year, 1881, he writes: "This appeal has never yet met with any response, and such silence is the most eloquent testimony in favor of the method that I could possibly have desired." "This silent eloquence is of greater value, when the ardor is considered with which the adversaries of animal vaccination, of whom a few rare specimens still exist, would have collected the failures; or, if we remember, taking the larger and more general view of the immunity procured by all kinds of vaccine inoculation, that Belgium has had the honor of being the native country of the illustrious President of the International League of anti-vaccinators, who no doubt would have been overwhelmed with the purest delight by such a discovery."

From this testimony we may conclude that if no case of post-vaccinal small-pox has been observed in the course of eleven or twelve years, out of more than 10,000 vaccinated with animal virus, the instances, if there have been any at all, must have been exceedingly rare. And the conclusions of the whole matter from all the foregoing evidence seem well established:

1. That in point of protective power bovine virus is superior to humanized virus.

2. That humanized virus but few removes from its bovine origin is but slightly, if at all, inferior in protective power to the bovine. But that continually transmitting it through the human system is a cause of slow, gradual, and certain deterioration.

The quality of the virus is a matter of such grave concern, that its consideration is not complete with establishing the superiority of bovine over humanized virus, in point of protective power. The bovine vaccine is superior also in other regards.

For a long time a want of confidence in the entire safety of using humanized lymph has been felt. The spectre of other and dread diseases being communicated to the subject of vaccination haunts the mind of anxious parents, and always prompts the earnest question, Is the "matter" good and pure? This fear has been somewhat increased since the occurrence of a few instances of the inoculation of syphilis has been noticed. Although those cases have been, among the many millions of people who have been vaccinated, so exceedingly rare that but very few indeed

have been well authenticated, yet enough have been verified to establish the possibility of such results from the use of humanized virus.

This danger, remarkably slight though it be, is wholly avoided by avoiding humanized virus and by using the bovine, because kine are not subject to that disease.

Confidence in the safety of animal lymph is still further increased, because the results of all scientific investigation of the communicability of the disease of kine to man goes to disprove the possibility of inoculating any diathetic disease with bovine vaccine lymph.

ERYSIPELAS PRODUCED BY VACCINATION.

Up to September, 1870, when Dr. H. A. Martin, of Boston, imported the first bovine virus of the celebrated Beaugency stock from France, the long-humanized virus (often called the Jennerian, because it had not been renewed since the time of Jenner) was almost universally employed. The occasional occurrence of *erysipelas* after vaccination with the Jennerian stock was an evil which no degree of prudence in the selection of the virus, study of coincident influences or of the condition of the subject, could altogether guard against. The liability to this disease, which was always a serious complication when it occurred, and which sometimes resulted fatally, was a source of constant anxiety to the operator and the patient and friends, and not infrequently a cause of unjust blame.

It is now eleven years since the importation of the bovine stock into this country, and many hundreds of thousands have been vaccinated with it, affording an experience sufficient to base a judgment of its merits upon. It is said that *erysipelas* is particularly liable to occur in re-vaccination with humanized virus. Dr. Martin asserts that, with his own hand, in 1872-73, he re-vaccinated about twelve thousand patients with bovine virus, and there was not one case of *erysipelas* among them all, and he had never known a case following the use of bovine virus at any other time. In 1877, he publicly announced in the *Boston Medical and Surgical Journal* for February, that bovine virus was not only exempt from the risk of causing *erysipelas*, but that it was absolutely *prophylactic of erysipelas*. It protects from *erysipelas*.

In reply to an inquiry by the writer, if his more recent experience since 1877 had given him any reason to modify his opinion

in regard to this invaluable and important quality of bovine virus, he writes, in a letter dated Dec. 9, 1881, as follows: "The immunity from erysipelas, either during the course or after the course of the vaccina induced by the use of true bovine vaccine virus (*i. e.*, virus from a young bovine inoculated from another, and so on back to original "spontaneous" cow-pox in the milch cow) is something ascertained beyond all doubt or question."

This testimony by a competent witness, after so many years of watchful observation, and when the bovine virus has been used upon persons to the number of several millions, ought to be conclusive.

These facts seem to be well established, viz.: that bovine virus is more protective than long-humanized virus; that it is free from the danger of communicating other diseases, and especially syphilis; and that erysipelas, which is the pest of humanized virus, does not occur at all after the use of bovine virus, but that it is even *prophylactic of erysipelas*.

For it is scarcely conceivable that so many individuals could be wounded, even so slightly as by an abrasion or puncture of the skin, without some of them suffering from erysipelas, if the application of the bovine lymph was not protective against it.

But all these superior merits of bovine virus apply only to a pure and genuine virus.

The business of producing the bovine virus has been undertaken in this country by a host of persons, some of whom have more enterprise than skill or knowledge of the subject, and often with so sharp a scent for the pecuniary profits that their moral integrity forms no obstacle to putting in jeopardy the public health, if their gains may be thereby increased.

The cultivation of bovine vaccine virus may be justly considered a skilled pursuit, requiring for success a liberal measure of training, experience, judgment, and knowledge. Whoever may possess these qualifications and will faithfully employ them can always produce virus of better quality than one who is deficient in them. It is not a mere manufacturing business, in which success depends upon getting the largest returns from the smallest outlay. Nor is it a commercial calling wherein a shrewd observer can surpass his competitors by buying and selling with judicious reference to the fluctuations of the market. In short, it is a pursuit in which money-getting should always be (although it is not always) secondary to the production of a safe and reliable vaccine virus,

which will most effectually protect our fellow-citizens from the contagion of small-pox.

Bovine virus is supplied for use in several forms, as,—the crusts formed by the drying of the vesicles, the lymph stored in small glass tubes, and the lymph dried upon the points of quills or upon bits of ivory prepared for the purpose. In other countries, still other methods have been practised. In Italy, the entire pustule has been excised from the animal and preserved between bits of glass. When used, fragments of the flesh thus excised are inserted in the arm of the subject. On one occasion, thirty-eight children, vaccinated from such portions of cut-out pustules in a state of putrefaction, were seized with convulsions and phlegmonous inflammations, and many of them died.

The dried crusts taken as they spontaneously separate from the animal contain the active lymph in a dry state, well adapted, with care, to preserve its active properties a long time. Much care and attention to the condition of these crusts, as well as to their selection, is requisite to insure satisfactory results from their use.

Crusts or scabs are, however, composed of varying proportions of lymph, mixed with epidermis, debris, and perhaps pus, all of which is animal matter and liable to putrefactive changes, which may cause an unhealthy action in the party vaccinated; and for this reason they are not recommended as the best form of preserving the vaccine lymph. Besides, a considerable portion of the crusts prove to be inert, and no amount of skill yet attained by experts enables them to distinguish always the good crusts from those which are worthless. Lymph preserved in glass tubes have been much employed. But experience with these demonstrates that it is an unreliable method of preservation, the lymph being immediately subject to change on exposure to the air. This method is almost fallen into complete disuse, though at one time quite popular.

The most approved method now practiced of preserving lymph is by collecting it from the vesicles at the period of their maturity upon thin lance-shaped pieces of ivory, upon which the lymph dries in a firm, thin layer. It is then wrapped carefully in cotton-wool, tissue-paper, and finally an outer covering of impervious gutta-percha, which effectually excludes air and moisture. Prepared in this manner, it has often been sent to the most distant countries without any deterioration of its active properties.

"PATENT SOLID LYMPH CONES"

is another form of vaccine virus found for sale by instrument dealers, druggists, etc. The statements made in the circular publishing the virtues of these "patent cones" are so much at variance with the real facts respecting them, as revealed by a careful examination of them, that it would seem to be within the lines of the legitimate and proper duty of the State Board of Health to openly caution the citizens of the State regarding their fraudulent and dangerous character.

The said circular, which *lies* before me, describes them as being "*consolidated lymph*," and as "*solid lymph made into a thick mass*." These remarkable statements are alone sufficient to excite the suspicions of any one having any practical knowledge of the business of producing lymph. The writer is informed by experts that an amount of "consolidated, solid lymph," enough to make one of these cones could not be produced for more than one hundred times the price named in the advertisement. One gentleman, who is among the most eminent vaccinographers in this country, and who has been a large producer of animal vaccine, writes me, that, if every particle of the little tears of dried lymph which could be obtained from two hundred heifers could be carefully collected, it would not be enough to make one "solid cone" of the size which is advertised by the New England Vaccine Company to sell for three dollars. In the same veracious (?) circular, it is asserted that "these cones are entirely free from any trace of pus, debris, or epidermis," thus attempting to impress still more forcibly the previous statement that they are only "solid lymph."

The writer submitted for examination one of these cones to Dr. T. Mitchell Prudden, Director of the Physiological and Pathological Laboratory of the College of Physicians and Surgeons of New York, and Lecturer on Normal Histology in the Medical Department of Yale College. The following is a copy of his written report of his examination:

"NEW YORK, July 1, 1881.

"DEAR DOCTOR: I enclose the report of the examination of the cone of virus, and send you a slide for examination with a pocket glass of low power, which shows some of the hairs, &c., taken from the portion which I examined.

"Sincerely yours,

T. MITCHELL PRUDDEN.

"TO DR. CHAS. A. LINDSLEY."



MICROSCOPICAL DRAWING FROM A SOLID LYMPH CONE, AS DESCRIBED.
a HAIRS, *b* PART OF A LEAF, *c* VEGETABLE FIBRES, *d* AMORPHOUS MATTERS.

THE REPORT.

"The mass consists largely of larger and smaller clusters of epithelial cells and cell detritus, together with a large number of hairs, some broken off and others torn out by the roots. Besides these things there are fragments of vegetable substances of various kinds, fibres, bits of seed, etc., shreds of connective tissue fibres, starch granules, and considerable colored amorphous material whose nature I am unable to determine. A few lymph cells and fragments of the same are also present.

"Quantitative results were not sought for; but from about half of the single cone I picked out seventy-four fragments of hair which were readily visible to the naked eye, and many more were left, which were readily seen by low powers of the microscope."

Such is the wretched mixture that the patentee offers to the public as "solid lymph." It seems to be constructed on the same idea that masons make mortar, to be held together with hair.

Any physician with an appreciable sense of the dangers of septic poisoning would never venture to inoculate a patient with such a compound of animal and vegetable matter, liable at any moment, under favorable conditions, to take on putrefactive changes, which might render it fatally poisonous.

In the proceedings of the Medical Society of the County of Kings, N. Y., for April, 1881, is an account of a death after using one of the cones obtained from the New England Vaccine Company, occurring to an officer in the U. S. Navy, and reported by the surgeon.

The following are extracts from the ship's medical journal:

"March 2d. Whittaker, Chief Engineer. Left arm very much inflamed from recent vaccination."

"March 3d. Whittaker, Chief Engineer. No fever; headache and lumbar pain much moderated; left arm very inflamed and painful; inflammation erysipelatous in appearance."

"March 4th. Whittaker, Chief Engineer. Not much constitutional disturbance; condition of arm no better; erysipelatous inflammation extends from elbow to shoulder; whole circumference of arm involved; surface of skin exteriorly covered with blebs."

"March 5th, 6th, and 7th. At home ashore."

"March 8th. Whittaker, Chief Engineer. Febris—sick leave."

"March 9th. Whittaker, Chief Engineer. Erysipelas. No im-

provement in the condition of the arm. He is under the care of Dr. S., of Brooklyn."

"March 10th. Whittaker, Chief Engineer. Erysipelas. Information was received this morning that Mr. Whittaker grew worse the early part of the evening, and died about 10 o'clock, P. M."

The above record leaves little doubt that the virus used in the vaccination was the cause of the erysipelas and death.

The surgeon making the report writes that "this is the only case of erysipelas or disease of any kind which he has observed from vaccination, . . . but the Powhatan lying near us had one fatal case some weeks ago."

All the bad results of impure vaccination do not get into print. But it needs but very few such sad events as the above to maintain and intensify the popular prejudice against all vaccination, however prudently and scientifically done.

It is a very serious misfortune, that so good, so safe, and so essential a means of public safety should be questioned and doubted and its usefulness limited because it must share in the public mind all the odium and reproach which justly should attach only to the imperfect, deceptive, spurious, and injurious kinds of vaccination. Yet such will continue to be the fact so long as it is popularly believed that old women, druggists, midwives, clergymen, schoolmasters, etc., are competent to properly perform the operation and pronounce upon its results. Such will continue to be the fact, so long as the intense commercial competition in the production of cheap virus attracts venal-minded and mercenary men of every grade of capacity who may think it presents a chance for money-making. Such will continue to be the fact, too, so long as *physicians* culpably neglect to fully inform themselves as to the source and quality of the virus which they use upon their patients, and trust to druggists, instrument-makers, and traders of every sort, who, through their facilities for advertising, can offer them virus at the cheapest rates.

The evils resulting from vaccination are, in the present light of science, almost wholly avoidable. With scarcely an exception, every unfortunate result from vaccination may be justly attributable to ignorance or inexpertness on the part of the vaccinator or a culpable carelessness in the selection of the virus.

Besides the dangers which may follow the use of poisonous virus, there is a far greater mortality resulting to persons who contract small-pox, while living in supposed security, on account

of their vaccinations having been spurious and imperfect. "What is called vaccination," says Dr. Elisha Harris, "is, in a vast number of persons in the United States, only so in name, and not in reality." As Mr. Marson has said concerning vaccination in England, so in the United States: "All persons, amateurs, druggists, old women, midwives, etc., are allowed to vaccinate in any way they may think proper, and the persons operated on are considered to have been vaccinated."

It will probably be a long time before public intelligence will attain to so high a standard as to tolerate the interference of the state or of sanitary authorities with the rights of private citizens to be vaccinated in any manner, and by any one, or with anything, that said citizens may select, and to pay for it and take whatever consequences may ensue. But as the eminent English sanitarian Mr. Simon says: "No principle can be more obvious than this; that if the state professes to vaccinate the people, above all, if it compels the people to be vaccinated, it must take every possible security for the excellence of the vaccination which it offers."

The subject is one of such momentous importance to the public welfare, that it is worthy of profound attention. The wide-spread prevalence at this time of small-pox in every direction throughout the whole country will give occasion for a vast deal of vaccinating and re-vaccinating.

Is it practicable to restrict the use of the vaccine virus, with which the market is flooded by irresponsible producers, by providing on the part of the state, to all qualified practitioners, a sufficient supply of a quality reliable, safe, and trust-worthy, obtained under such official supervision as would insure such quality, and sold at so low a rate as to destroy any competition, while at the same time it should be so carefully produced as to be entitled to the fullest confidence?

Dr. W. M. Welch, physician to the Municipal Small-Pox Hospital of Philadelphia, Pa., speaks as follows, on this point: "For better protection against a pestilential disease which is constantly recurring, and which is frequently most destructive to business and commerce, the propagation of animal lymph of perfect quality is of so great importance to the public that it should not be left solely to private enterprise, nor degraded to the level of a commercial trade, but should be under the control of the national or state government, so that lymph of undoubted good quality could always be obtained free of cost."

WHAT ARE THE EVIDENCES OF A SUCCESSFUL VACCINATION?

As has already been observed, large numbers of persons are vaccinated only in name and not in reality. It is therefore a matter of much importance to know confidently and reliably in which list a person rightfully belongs, that he may govern himself accordingly.

In the early days of vaccination the test was, subsequent inoculation with the small-pox. In Jenner's time the protective efficacy of vaccination was very frequently tested in that way. Within two or three years after Jenner announced his discovery, he reported that upwards of six thousand persons had been inoculated with the virus of cow-pox conveyed through a succession of human subjects, and the far greater part of them have since been inoculated with that of small-pox, and exposed to its infection in every rational way that could be devised, without effect."

Such a test proved beyond question the protective power of vaccination. That fact is no longer in dispute. No fact in medical science is more firmly established. It is in these days, therefore, only needful to know that one has been the subject of a genuine vaccination to know that he is thereby protected.

Vaccination produces a specific disease, *vaccinia*, with diagnostic indications so well marked that an expert does not mistake them. The beginning, progress and termination of the inflammation excited by the inoculation of a person with the virus of cow-pox is so characteristic, when it is undisturbed in its natural course, that it is unlike any other, and can be recognized and identified as a vaccination by an intelligent person of good powers of observation, who has had frequent opportunities of seeing true vaccinations. But without such opportunities, or without the ability to improve them, the diagnosis cannot be made. Such an one has no hesitation in pronouncing every sore arm, following his punctures or his scratches, a successful vaccination, whatever condition it may present, whether spurious or genuine. Not infrequently the sore upon the arm arising from the insertion of worthless virus is even more severe than that resulting from the genuine lymph. Hence the dangerous error of entrusting an operation, the success of which one's life may afterwards depend upon, to an unskilled and incompetent person, who cannot distinguish between a common or an erysipelatous inflammation and the specific indications of *vaccinia* which result from the inoculation of vaccine virus, and which only afford safety from small-pox.

It would serve no good purpose, and is not within the intended scope of this paper, to describe at length and minutely the diagnostic marks of true *vaccinia*. The object is rather to impress upon the reader the serious fact, that vaccination is an *event* of weighty significance, the influence of which is of such consequence that a large portion and perhaps the whole of his life will be affected by it. The simplicity of the operation, and the inconsiderable illness which usually succeeds it, should not blind any one to the fact, that it is an event of deep concern to every individual. It is *not* the trivial thing which many regard it, to be ignorantly or negligently performed and with uncertain effect.

HOW OFTEN SHOULD VACCINATION BE REPEATED?

The subject of re-vaccination is one upon which much difference of opinion exists in regard to some minor questions. But upon the importance of it, and the use of it, as a general rule of practice, there is great unanimity of opinion.

Why is re-vaccination necessary?

There are two essential causes for it; one is, because the primary vaccination was defective.

Jenner recognized this necessity, and he was accustomed to do what is altogether too much neglected now, that is, to watch the vaccinations throughout their entire course, and if any irregularity occurred, to advise re-vaccination immediately, or at some early convenient period; because he had already learned that such vaccinations were not fully protective and could not be depended upon as security against small-pox.

In these latter times, when negligence, ignorance, or defective lymph so frequently vitiate the results of vaccination, this cause for a re-vaccination is vastly more common than in its early history.

It is the more unfortunate that it is so because the primary vaccination, if it has taken, but taken *badly*, will often prevent the success of a re-vaccination. And so a child who has had only a spurious vaccination is only partially, if at all, protected from small-pox, and yet is prevented from securing the protection which a good primary vaccination would have afforded.

This is another and a very important reason why the primary vaccination, at least, should always be performed only by a competent and careful operator. An imperfect primary vaccination is a very great misfortune. Re-vaccination cannot be relied upon to

make good the defects of a primary vaccination, although it is the best means of remedying the evil which can be employed. Another defect of primary vaccination is due to the application of too minute a quantity of vaccine lymph, the operation being perfect in other regards.

Dr. Marson, who was for many years physician to the London Small-Pox Hospital, shows, by an "analysis of his cases, that the mortality in post-vaccinal small-pox bears a very distinct relation to the quality and amount of the vaccination as evidenced by the number and character of the vaccine scars. His analysis showed that, of patients with one cicatrix over 9 per cent. died, of those with two marks 6 per cent. died, with three about $3\frac{1}{2}$ per cent., and of those with four and more only about 1 per cent. It showed, also, that in cases with good cicatrices less than half the number died than died among patients with indifferent marks."

This evil is largely obviated by the recent method of vaccination, which is by abrading a portion of the skin and applying the virus to the raw surface. This pretty uniformly secures the application of the lymph over as large an absorbing surface as would more than equal the two, three, or four punctures that used to be made in inserting the virus. So that a vaccination by the modern method is *generally* equivalent to three or four punctures by the old method. The other reason why re-vaccination is necessary is that experience has determined, beyond a doubt or question, that, in addition to those who are only partially protected by reason of irregular or spurious primary vaccination, there is another class of no inconsiderable numbers, who, notwithstanding perfect primary vaccinations, have gradually acquired a renewed susceptibility to the contagion of small-pox in greater or less degree. It is not possible to distinguish this class from those who still enjoy the full protection afforded by vaccination. If such discrimination could be made with assurance it would be necessary to re-vaccinate only such as needed it. But the impossibility of knowing which, in a vaccinated community of adults, are liable to the infection of small-pox and which are not, involves the necessity of giving the means of protection to all.

Re-vaccination, therefore, is a wise proceeding, on the part of grown-up people, as affording probable needed security to such as have had defective infantine vaccinations, and as affording an additional security even to the best vaccinated, as no individual can tell whether he may be one of the great majority who are

fully protected, or one of the small minority who are only partially so. Persons who have faint cicatrices with ill-defined characteristics need vaccinating more than those with good marks. Persons with one or two scars only need it more than those with three or four good ones.

AGE AT WHICH RE-VACCINATION SHOULD BE DONE.

Supposing the primary vaccination in infancy to have been unexceptional, the teachings of experience are, that the subject is safe until the period when the growth of the body is about being completed, the age of puberty. During this transition stage between youth and adult life, the changes in the system are attended in a small minority of persons with a partial loss of the protective power of vaccination, and that is a period beyond which a person possibly incurs some degree of risk if not re-vaccinated.

The importance of re-vaccination at this age is more urgent in proportion as the indications of a good primary vaccination are wanting. A good and sufficient primary vaccination is, as a rule, then fully protective until the age of twelve or fifteen years. The only circumstances under which an earlier repetition would be advisable are a known exposure to the infection of variola or the prevalence of an epidemic of the disease.

As to subsequent re-vaccinations, the weight of evidence is, that an adult re-vaccination with true bovine virus with positive vaccinal effect will be fully protective against small-pox for the remainder of life; or, as Dr. Martin says, the subject will be as insusceptible of small-pox as "if he or she had twice had that disease." This strong assertion it is certain cannot truthfully be made with the long-humanized virus. Its enfeebled protective power has been again and again demonstrated by the frequent occurrence of varioloid and even variola after adult re-vaccination with it.

The diversity of opinion respecting the needed frequency of re-vaccination is mostly due to not recognizing this difference in the protection afforded by the two kinds of virus.

When the Jennerian or long-humanized virus is employed (and it is only that which, until within ten years, we have had experience with), re-vaccinations should be made as often as every five to ten years, and especially whenever an epidemic of small-pox is prevailing. With true bovine virus a primary vaccination in infancy and a re-vaccination at puberty is all that is required.

THE AGE AT WHICH PRIMARY VACCINATION SHOULD BE PERFORMED.

This is a matter of much practical interest.

If an infant has been exposed or is liable to be exposed to the infection of small-pox it should be vaccinated at once, however young. There is the less objection to vaccinating infants of very tender age with the bovine virus, because there is no danger of erysipelas, which is the great dread when humanized virus is employed. But if there is no known risk of exposure the operation may safely be delayed until the age of three or four months, but not longer, because soon after this the period of active dentition begins, with its attendant irritations and frequent derangements. During this period vaccination should not be attempted except for necessity, because it might not take, or it might be rendered imperfect by the other disorders of the system, and thus impose upon the child the misfortune of an imperfect primary vaccination. So that if not vaccinated before the time of teething, it is desirable to postpone it until after that process is mostly over. This waiting prolongs, by several weeks or months, the period of exposure, during which the child must be more closely guarded, and cannot without some risk be taken even upon the street, or make journeys, or be carried in any public places.

The importance of an early vaccination is the more impressive when we remember that young children have always been the most numerous victims of small-pox. The statistics of England show that one-fourth of all the fatal cases are of children under one year of age.

CHILDREN SHOULD BE IN HEALTH WHEN VACCINATED.

This rule does not necessarily exclude many children who are sickly and feeble. Scrofula does not prevent the full development of vaccinia, nor would the latter stages of chronic whooping-cough forbid the operation, and so of some other chronic disorders, but acute febrile diseases do always. Except under pressing necessity, skin affections, particularly those of a vesicular form, as herpes, eczema, and intertrigo, should occasion the postponement of the operation until they are cured.

A careful vaccinator will always examine if there be any uneruptive disorder upon his patient, such as often is found behind the ears, any chafing in the folds of the neck or in the groins, before he operates.

The trained observing powers of Jenner early detected the interfering influence of cutaneous diseases, and he described how they prevented the full and correct reception of the vaccine influence. His rule of practice was "to sweep away *all* eruptions from the skin previous to inserting the vaccine lymph."

The period of weaning is an unsuitable time for this operation, for obvious reasons. It should not be performed, except under the most pressing need, during epidemics of any of the severe diseases of children. Also, except for urgent cause, during the seasons of extremes of temperature it had better be postponed.

CONCLUSIONS.

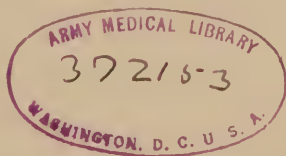
1. That the vaccinia produced by the proper inoculation of vaccine virus protects the subject as much as an attack of small-pox.

2. That wherever compulsory laws are enforced, the protection afforded by vaccination is satisfactorily demonstrated.

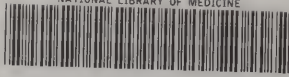
3. That as between the two kinds of vaccine virus now in use, viz., the bovine and the humanized, the bovine is to be preferred. (a.) Because it is fully protective, while the humanized gradually loses its protective power by frequent transmissions through the human system. (b.) Because bovine is exempt from the risk of communicating other diseases than vaccinia, while the humanized virus is liable to produce erysipelas, and in rare instances has conveyed the poison of syphilis.

4. That the vast importance of this subject, as it concerns the public welfare, forces the inquiry: If the best interests of communities do not demand that a supply of genuine, trustworthy, bovine virus should be always provided by skilled producers, under the official direction of the state or national governments?

5. That a primary infantile vaccination with good bovine virus is fully protective until the age of puberty, and that a re-vaccination at or about that time, resulting in any perceptible vaccinal effect, will be protective through the remainder of life.



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